Best Available Science

Critical Aquifer Recharge Areas

Prepared for the City of Sammamish
by AMEC Environment & Infrastructure, Inc.

Introduction

This memorandum summarizes the findings of a Best Available Science (BAS) Study for critical aquifer recharge areas (CARA) prepared for the City of Sammamish (City).

Puget Sound-Wide Issues

As a result of WAC 365-190-030, municipalities now perform routine Critical Area Ordinance (CAO) updates, which incorporate the review of hydrologic data unique to localities and any implications that changes that BAS imparts on CARA delineations. As part of this review performed for the City of Sammamish, no legislative changes were identified that would significantly impact CARAs that were identified as part of the 2005 Critical Areas Update. The current understanding of the Sammamish area hydrogeology is based upon data contained within previous hydrogeologic reports and their implications for CARA delineation are discussed below.

Unique Conditions in Sammamish

CARAs are defined in Washington State as locations "where an aquifer that is a source of drinking water is vulnerable to contamination that would affect the potability of the water" (WAC 365-190-030). Areas that are most vulnerable to groundwater contamination can be identified by evaluating aquifer hydraulic properties (i.e., hydraulic conductivity, porosity, hydraulic gradients) and identifying sources to groundwater and stresses within the aquifer system (i.e., recharge, groundwater-surface water interactions, well discharge) (Focazio et al. 2002; King County 2004). To prioritize critical aquifer recharge areas, it is also necessary to identify and delineate resource areas where the impacts to groundwater would be significant for drinking water. High-risk areas can then be identified where there is conjointly high vulnerability to groundwater contamination and high value resource areas.

The East Lake Sammamish Basin Conditions Report (Basin Conditions Report) published in 1990 characterized the hydrostratigraphic units that are present immediately beneath the City of Sammamish area, including the aquifer formation used by the City for domestic water supplies (King County Surface Water Management Division 1990). The Basin Conditions Report indicates that the major aquifer formation lying beneath the City is Vashon-age advance outwash. The thickness of this unit varies between 100 and 200 feet and is generally overlain by a layer of glacial till. The glacial till behaves as an aquitard due to its relative lower permeability

and thereby limits recharge to the underlying aquifer. At the time of the Basin Conditions Report, it was understood that the till layer could minimize the potential for contamination impacts on the underlying aquifer due to the lower permeability of the till.

In 1995, the United States Geological Survey (USGS) issued a Geohydrogeology and Groundwater Quality report for East King County, which included the City of Sammamish. This study expanded upon the Basin Conditions Report by incorporating geologic boring logs to produce three geologic cross sections across the City of Sammamish. The cross sections illustrate that the till layer covers much of the Vashon advance outwash as suggested in the Basin Conditions Report; however there are areas within the City where the till is thin or nonexistent (Turney et al. 1995).

In 2005, CARAs were delineated for the City as part of their CAO update (Berryman & Henigar 2005). Wells that provide drinking water to the Sammamish Plateau Water and Sewer District and the Northeast Sammamish Sewer and Water District are located in a suburban environment; consequently, there is potential for groundwater impacts resulting from commercial activities. As part of the delineation, CARAs were subdivided into three respective wellhead protection zones. Two protection zones were based on wellhead protection mapping provided by Sammamish Plateau Water & Sewer District and the Northeast Sammamish Water & Sewer District (Berryman & Henigar 2005). The third protection zone was based on King County mapping of recharge areas (Berryman & Henigar 2005). The 2005 map that identifies delineated CARAs is attached. As part of this BAS study, it is assumed that capture zones were accurately delineated using procedures substantively compliant with the Washington Department of Health's Wellhead Protection Guidance Document (State of Washington 2010). Furthermore, WAC 365-190-080 identifies sole source aquifers, special protection areas, and other areas susceptible or vulnerable to groundwater contamination with a critical effect on CARAs. The City of Sammamish has included King County recognized recharge areas in their delineation of their CARAs, but it may be necessary to review the CARA delineation to include additional special protection areas that have been recognized since 2005.

At the time of the CAO update, the City of Sammamish Technical Advisory Committee (2005) conceptualized recharge to deep aquifers as follows:

> Many of the primary wells for Sammamish Plateau Water and Sewer District (Sammamish Plateau) and Northeast Sammamish Sewer and Water District (NE Sammamish) access deep aquifers and are less affected by surface drainage recharge within Sammamish city boundaries compared to recharge from other areas.

This statement implies that recharge to Sammamish Plateau and NE Sammamish production wells occurs along the western Cascade foothills and mountain front. It also suggests confining layers are present between shallower aquifers and the deep aquifer system where the Sammamish Plateau and NE Sammamish production wells are screened, as suggested by the Basin Conditions Report and Turney et al. (1995).

However, the findings presented in both the Basin Conditions Report and Turney et al. (1995) are general in nature. The Basin Conditions Report only used surface exposures to delineate hydrostratigraphic units, while the USGS (Turney et al. 1995) used 16 well logs to develop their

geologic cross sections. While both reports are correct that widespread till is present above the aquifer beneath the City and this till limits recharge to the underlying aquifer, neither reports address smaller scale variability in the continuity of the confining layer, small scale variability in the permeability of the till, or the susceptibility of other private and group wells that may be screened within shallower aquifers. Wells screened in systems with an absent or less competent overlying aquitard would be inherently more susceptible to contamination from surface activities within the City boundaries.

Even where till is present, it is now recognized that contaminant migration can occur through till layers and impact underlying aquifer systems. Furthermore, the presence of the Seattle fault zone, which intersects the southern portion of the City, may result in displacement of till, fracturing, and/or faulting that could lead to the creation of preferential flow paths to the underlying aquifer. These preferential flow paths could increase the risk of surface contamination reaching the lower aquifer system used to supply the City of Sammamish with water supply.

Implications for Existing City Regulations

Many land-use activities can potentially affect the quantity and quality of groundwater recharge adversely, and the City should institute measures to protect groundwater resources if these activities occur within a recognized CARA. This recommendation is consistent with the City of Sammamish Municipal Code Chapter 21A.50.280. The code identifies different class CARAs based upon wellhead protection areas and King County Recharge maps. Specific land use types are then listed as prohibited depending on the CARA class.

Contamination toxicity information and cleanup levels are periodically updated by the Washington Department of Ecology for human health and ecological exposure pathways via ingestion, inhalation, and dermal exposure to groundwater and/or surface water. Land use types that are prohibited or restricted as per SMC 21A.50.280 should be updated as information about potential chemical use toxicity is updated. The Washington Department of Ecology will be updating the groundwater and surface water cleanup levels within the next 18 months as part of an overall Model Toxics Control Act (Ch. 173-340 WAC) rules revision.

Based on experience with groundwater monitoring in urban areas, it is recommended that the City consider restricting additional activities that involve fertilization or application of pesticides to Table 21A.50.280a. As would be similar to the effects from a golf course, other activities that use nitrates, phosphorus, pesticides, and other chemicals have a potential to degrade groundwater and surface water quality when used inappropriately or in excess. Additional activities could include land uses such as ball fields and plant nurseries.

Research or Monitoring Needs

The USGS is currently performing updates to the Bellevue North (Redmond) and Bellevue South (Issaquah) quadrangles, which will collectively provide delineation of surface geology within the City of Sammamish. When issued by the USGS, these maps should be reviewed to

identify any additional detail or changes in the understanding of the geologic units within the City of Sammamish. In addition, a comprehensive review of well logs within the City of Sammamish area has not been performed since Turney et al. (1995). When the USGS issues the new quadrangle maps, a review of geologic boring logs should be performed to identify any additional geologic data from new wells that have been installed since 1995.

Attachment: 2005 CAO Update Draft Critical Aquifer Recharge Areas

Specific References

Berryman and Henigar, 2005, *City of Sammamish Washington 2005 CAO Update Draft Critical Recharge Areas*, October. (Attached)

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WAC 365-190-030, *Minimum Guidelines to Classify Agriculture, Forest, Mineral Lands and Critical Areas Definitions*. http://apps.leg.wa.gov/WAC/default.aspx?cite=365-190&full=true#365-190-030

WAC 365-190-100 *Critical Aquifer Recharge Areas*. http://apps.leg.wa.gov/WAC/default.aspx?cite=365-190&full=true#365-190-100

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WAC 173-160 – *Minimum Standards for Construction and Maintenance of Wells*. http://apps.leg.wa.gov/wac/default.aspx?cite=173-160

WAC 246-290, *Group A Public Water Supplies*. http://apps.leg.wa.gov/wac/default.aspx?cite=246-290

City of Sammamish
WASHINGTON

2005 CAO UPDATE

DRAFT

Critical Aquifer Recharge Areas

Available GIS information shown may not include all critical areas and locations have not been verified. Data from other cities is not included.

Legend

- City Limits
- Urban Growth Boundary
- Water Bodies
- Wetlands
- Streams
- Water Supply Wells, Group A
- Water Supply Wells, Group B
- Other Water Supply Wells

Wellhead Protection Zones

- Class 1 - 1 year TOT
- Class 1 - 5 year TOT
- Class 2 - 10 year TOT
- Class 3

N W E S

0 2,500 5,000 Feet

DATA SOURCES: Class 1 & 2 protection zones are based on well head protection mapping provided by Sammamish Plateau Water & Sewer District (2005) and the Northeast Sammamish Water & Sewer District (2005). Class 3 protection zone based on King County mapping of recharge areas(2002).

This map is a geographic representation based on information available. It does not represent survey data. No warranty is made concerning the accuracy, currency, or completeness of data depicted on this map.

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